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Non-Provisional Patent Application of:

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For:

Apparatus and Methodology for Embossing Fibrous Webs Containing Contaminants

APPARATUS AND METHODOLOGY FOR EMBOSSING FIBROUS WEBS CONTAINING CONTAMINANTS

Cross-Reference to Related Applications

This application claims the benefit of the filing date of U.S. Provisional Patent Application Serial No. 60/159,761, filed October 15, 1999.

Technical Field

The invention relates to embossing of paper products, for example, paper towels, toilet tissue and napkins, in which an improved embossing combination is used which is particularly suitable for the embossing of paper products made from recycled pulp.

Background of the Invention

Paper products, such as paper towels, napkins and toilet tissue are widely used on a daily basis for a variety of household needs. Typically, such products are formed of a fibrous elongated web which is either packaged in rolls or in a folded stack. The fibrous webs are usually embossed to increase the bulk of the tissue and to improve the absorbency, softness and appearance of the product both as individual sheets, and in providing a uniform stack or roll package. Embossing can also aid in holding superposed plies of a web together. A commonly used embossing apparatus includes one or more steel embossing rollers having male protuberances thereon for forming the embossed pattern, and a corresponding steel roller which includes matched or mated female recesses which are a three dimensional mirror image of the male protuberances. The web passes between the nip (gap) of the male and female embossing rollers such that the embossed pattern is imparted to the web.

Recently, environmental concerns have led to the use of greater amounts of recycled pulp in the production of paper products. However the economies of recycling make it practically impossible to remove all contaminants from the recycled pulp. In particular, recycled pulp often contains contaminants such as particles of glue and small pieces of plastic which adhere to the pulp, and which are known as "stickies". These contaminants when passed through the embossing rollers of paper production equipment may adhere to, or become lodged in, the protuberances or recesses of the rollers causing excess wear and possible damage to the embossing rollers, thus negating the savings had from the use of recycled materials. If on the other hand, the clearances embossing machinery are adjusted to accommodate possible contaminants in the recycled pulp, the qualities of the finished paper product may be adversely affected, which will render such recycled pulp based products less commercially attractive.

The present invention is directed to apparatus and methodology to provide embossing of recycled pulp without adversely affecting the processing machinery. This enables the recycled pulp to be embossed in a manner similar to that of non-recycled pulp which provides an absorbency, softness and appearance to the finished product which compares favorably to paper products made from non-recycled pulp. It has been found that recycled pulp can be embossed in a manner comparable to that of non-recycled pulp, even if it contains contaminants, if the embossing is carried out by matched embossing rollers in which one of the rollers is relatively soft Shore A (durometer) hardness of 40-65 and the other roller is relatively hard Shore A (durometer) hardness above about 90. The hard roll of the matched set may be a steel roll which is "off" of the Shore A hardness scale. As used herein, the terminology having a Shore A hardness of at least about 90 and the like or "greater than about 90" includes harder surfaces such as steel surfaces whether or not a different hardness scale would be applicable. As one of skill in the art will appreciate, a P&J hardness

scale is applicable to steel surfaces. Recycled pulp, even containing contaminants, may be embossed in this manner without causing excess wear or damage to the embossing rollers.

As used herein a matched set of embossing rollers means that the male embossing elements, carried by one roller, are engraved first and the female elements carried by the other rollers are subsequently made from the male elements, or vice versa, so that both elements are virtually inverse or reciprocal images of each other within the practicalities of manufacturing tolerances. This is in contrast to "unmatched" embossing rollers in which the male and female embossing elements are not identical in shape, but still are positioned relative to each other in registry such that they engage.

It is an object of the present invention to provide apparatus and methodology for embossing webs that will avoid damage to the processing machinery should the web contain contaminating particles.

It is an object of the present invention to provide apparatus and methodology for embossing paper products that will permit processing of recycled pulp without causing excess wear or damage to the processing machinery.

It is an object of the present invention to provide apparatus and methodology for embossing paper products that will permit older embossing machinery having matched embossing rollers to be retrofitted with a matched roller that can accommodate pulp that may contain contaminants, such as recycled pulp.

Background Art

U.S. Patent Nos. 5,503,896 and 5,529,563, both to *Veith et al.*, disclose methods for embossing webs using unmatched male and female embossing elements which are preferably made by laser engraving rubber embossing rolls (see, e.g., col. 3, lines 49-52 of U.S. Patent No. 5,503,896). The male and female embossing elements can be made of different materials. For example, the male elements can be made of steel, and the female elements can be composed of a deformable material, such as rubber, or vice versa (see, e.g., col. 4, lines 3-5 of U.S. Patent No. 5,503,896). The web can be any web suitable for embossing, including paper, tissue, nonwovens, films, laminates, combinations thereof and the like (see, e.g., col. 4, lines 10-13 of U.S. Patent No. 5,503,896).

U.S. Patent No. 5,727,458 to *Schulz* (the inventor herein) discloses an embossing method wherein two plies of web material are multilevel embossed between rigid engraved embossing rolls and backup embossing rolls. The backup embossing rolls can be composed of laser engraved rubber (see, e.g., col. 3, line 64 and col. 4, lines 56-57 and 67). The non-backup embossing rolls are generally composed of steel but may be substituted with laser-engraved rubber rolls (col. 4, lines 16-21). The backup embossing rolls may have a mirror image engraving of the embossing pattern on the non-backup embossing rolls (col. 4, lines 64-66). The embossing method can be used to make toilet tissue and paper towels (col. 3, lines 53-54).

United States Patent No. 5,269,983 to *Schulz* (the inventor herein) describes a method of embossing involving a mated pair of resilient and rigid embossing rolls. According to the '983 patent a laser can be utilized to form recesses in a resilient roll such that the resilient roll receives protuberances of a rigid male embossing roll when the rolls are placed in contact.

Brief Description of the Drawings

For a better understanding of the invention reference is made to the following drawings which are to be taken in conjunction with the detailed description to follow:

FIGURE 1 is a side view of a paper product embossing apparatus in accordance with the present invention.

Figures 2a and **2b** illustrate the nip between the processing rollers with **Figure 2a** showing the embossing of a portion of a web that is free of contaminating particles and **Figure 2b** showing the embossing of a portion of a web that includes a contaminating particle.

Description of the Preferred Embodiments

Figure 1 illustrates the embossing apparatus **10** of the present invention which includes a pair of supply rolls **12, 14** which supply the fibrous web to be embossed. While a pair of supply rolls is shown, to form a two-ply web **16**, it is to be understood that multiple supply rolls may be provided for any desired number of plies or a single roll may be utilized to provide a single ply web or a multi-ply web in which the plies have been previously joined. A first embossing roller **18** is provided which has a "hard" outer surface having a plurality of protuberances **20** corresponding to the desired embossing pattern. The protuberances **20** are shown representatively, and may take any desired form, shape or number in accordance with the present invention. A second "soft" embossing roller **22** is provided having a deformable outer surface with female portions or recesses **24** provided which are matched to the embossing pattern of the protuberances **20**, such that as the rolls **18,22** are in rolling engagement, the protuberances **20** of the rigid roll enter the recesses 24 of the resilient roll. The hard and soft rolls thus cooperate to form the embossed pattern on the web. A hydraulic system may be provided as shown schematically by blocks **26,28** to allow for

separation of the rolls, for example, to allow initial feeding and registration of the web between the rolls, and to urge the rolls together for the embossing operation. A nip **30** is formed between rollers **18,22** and can be adjusted by the hydraulic systems **26,28**. Web **16** after being embossed, may then proceed to further web processing machinery such as a perforation roller **32**.

In accordance with the present invention it has been found that if one of the matched pair of embossing rollers is formed from material that is less hard than the material of the other embossing roller, webs containing contaminants can be embossed without excess wear or damage to the embossing rollers. Specifically, the "hard" roller should have a Shore A hardness greater than about 95 (including steel), preferably 95-99 for laser engraved rolls. The "soft" roller should have a Shore A hardness of 40-95 and preferably in some embodiments 40-85 or 40-75 or even more preferably 40-65. The particular material used for either roller is not critical, for example, the hard roller could be steel, or a hard rubber or plastic. The soft roller is preferably natural rubber but can also be synthetic rubber or plastic. A Shore A hardness of 60-65 is particularly useful in some embodiments. A natural rubber can readily be made into a mirror image of the other roller by a laser process to" read" the protuberances or recesses and "burning" away the rubber. Such a process is described in United States Patent No. 5,269,983 issued to *Schulz* (the inventor herein), the disclosure of which is hereby incorporated by reference as if fully set forth herein.

In a particularly preferred method of the invention, there is provided a method for embossing a fibrous web containing contaminants to improve the bulk and softness of the web by passing the web through a nip formed by a pair of rotating rollers, wherein the contaminants will not damage the rollers, the method comprising the steps of a) providing a first embossing roller having an outer surface, said outer surface having a plurality of male protuberances thereon corresponding to a desired

embossed pattern; b) providing a second embossing roll having an outer surface having a plurality of female recessed portions which are matched to the male protuberances of the first roll; c) wherein at least one of said first and second embossing rollers is a laser engraved roller and has a Shore A hardness from about 40-95; and d) placing the rolls in contact to form a nip between the rolls, with the protuberances of the first roll entering the recesses of the second roll as the rolls rotate together; and passing a fibrous web through the nip formed by the rolls to emboss the web wherein the roller having the Shore A hardness of 40 will deform if any contaminants are encountered in the fibrous web. More typically, at least one roller will have a Shore A hardness of from 40-85 or 40-75 with perhaps a Shore A hardness of from 40-65 being particularly preferred.

Figures 2a and **2b** illustrate nip **30** between rollers **18, 22** as they act on web **16**. In **Figure 2a** the portion of web shown 16 is free of any contaminants, it is seen than web **16** is embossed between the protuberances **20** of roller **18** and the recesses of roller 24 as web 16 is deflected therebetween, with the gap "a" defined as the distance between rollers **18, 22**. In **Figure 2b** the portion of web shown **16** includes a contaminating particle **40**, such as a particle of glue or plastic, it is seen that web **16** is again deflected between the protuberances **20** of roller **18** and the recesses of roller **24**, however particle **40**, which may be non-compressible, will also be lodged between protuberance **20** and recess **24**. However, as roller **22** is formed from deformable material a temporary recess **42** will be formed in recess **24** of roller **22** which permits particle **40** to pass without damaging rollers **18, 22**. If both rollers were formed from harder material contaminants would easily damage, or become lodged in, the rollers.

From the point of view of the operation of the present invention it is irrelevant

whether the soft roller is the male roller (having the protuberances) or the female roller (containing the recesses). However from a practical viewpoint, it is likely to be less expensive to manufacture the female roller from rubber as this will generally require the removal of less material in the laser engraving process. The present invention may be easily implemented on older embossing equipment as the only change required is the replacement of one of the rollers in each embossing pair. The embossing roller's drive equipment, roller diameters and lengths as well as spacing will all remain unchanged. Furthermore, the size and type of the individual embossing elements are not limited by the present invention as both microembossing and macroembossing of fibrous webs can be undertaken.

The present invention is applicable as well to the updating of older embossing machinery having matched steel rollers. One of each of the matched pair of rollers can be removed, and by the laser reading and burning process described above, a new soft roller can be created to match the steel roller which may then be installed in the embossing equipment. In this manner older equipment otherwise unsuitable for the embossing of recycled material can be utilized to carry out the present invention thus extending the useful life of the equipment.

The present invention is also applicable to embossing machinery using unmatched rollers in which one of the rollers is replaced by a soft roller having the hardness parameters set forth above. Finally, the use of two matched soft rollers having a Shore A (durometer) hardness of 40-65 and a Shore A hardness of 60 and preferably of about 80 could also be used to emboss recycled pulp without damage from contaminants in accordance with the present invention.

The invention has been described with respect to preferred embodiments. However, as those skilled in the art will recognize, modifications and variations in the

specific details which have been described and illustrated may be resorted to without departing from the spirit and scope of the invention as defined in the appended claims.